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CHALLENGES TO THE TRANSITION OF IPMC ARTIFICIAL MUSCLE ACTUATORS TO PRACTICAL APPLICATION

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Abstract

Ion-exchange membrane metallic composites (IPMC), which were first reported in 1992, are one of the electroactive materials (EAP) with potential applications as artificial muscle actuators. The recent introduction of perfluorocarboxylate-gold composite with tetra-n-butylammonium and Lithium cations instead of sodium made the most significant improvement of the material electroactivity. Under less than 3 volts, IPMC with the new constituents is capable of bending beyond a complete loop. Taking into account the fact that IMPC materials do not induce a significant force, the authors are extensively seeking applications for these bending EAP. Some of the applications that were demonstrated include dust-wiper, catheter guide, miniature motor, robotic-gripper, micro-manipulator, etc. Generally, space applications are the most demanding in terms of operating conditions, robustness and durability, and the co-authors of this paper are jointly addressing the associated challenges. Specifically, a dust-wiper is being developed for the Nanorover's infrared camera window of the MUSES-CN mission. This joint NASA and the Japanese space agency mission, is scheduled to be launch from Kagoshima, Japan, in January 2002, to explore the surface of a small near-Earth asteroid. Several issues that are critical to the operation of IPMC are addressed including the operation in vacuum, low temperatures, and the effect of the electromechanical characteristic of the IPMC on its actuation capability. Highly efficient IPMC materials, mechanical modeling, unique elements and protective coating were introduced by the authors and are making a high probability the success of the IPMC actuated dust-wiper.

electroactive polymers